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ABSTRACT

Quantitative financial measures were applied to evaluate the performance of the North Dakota Public Employee Retirement System (NDPERS) pension fund portfolios and the Teachers Insurance and Annuity Association (TIAA)/College Retirement Equities Fund (CREF) portfolios, thus providing a relative performance assessment. Ten years of data were collected for each retirement system, and these data were broken down into fixed income and equity components so that similar categories of investments could be compared. Results revealed that the North Dakota pension fund was not achieving an adequate risk-adjusted rate of return, and it was concluded that the relatively small size and conservative nature of the North Dakota pension fund limited its investment opportunities. Specific recommendations for performance improvement include: NDPERS should consider a switch to a defined contribution system; the state should investigate the 401K tax-deferred savings plan authorized by the Internal Revenue Act of 1978; the state should consider using a computer modeling technique to adjust the equity-fixed income asset allocation; and fund managers should contact the state's Congressional delegation to express concern over the issue of taxation of pension funds. Contains 19 references. (Author/SM)

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Comparative Analysis of TIAA/CREF and North Dakota Public Employee Retirement System Pension Fund

By

Jeong W. Lee

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COMPARATIVE ANALYSIS OF TIAA/CREF AND NORTH DAKOTA PUBLIC EMPLOYEE RETIREMENT SYSTEM PENSION FUND

by

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May 1989

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ABSTRACT

In this paper, quantitative financial measures are applied to evaluate the performance of the North Dakota Public Employee Retirement System pension fund portfolios and the Teachers Insurance and Annuity Association / College Retirement Equities Fund (TIAA/CREF) portfolios, thus a relative performance assessment is provided. Ten years of data were collected for each retirement system. These data were broken down into fixed income and equity components so that similar categories of investments could be compared. Results of the quantitative analysis reveal that the North Dakota pension fund was not achieving an adequate risk-adjusted rate of return. It is concluded that the relatively small size, and conservative nature of the North Dakota pension fund has limited its investment opportunities. Specific recommendations for improvement of the performance of the North Dakota pension fund are suggested.

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INTRODUCTION

As more and more dollars flow into the North Dakota pension funds, evaluation of the portfolio performance is expected to become increasingly important. It is of interest to the state of North Dakota and the pension fund beneficiaries to know the relative performance of this portfolio. The Public Employees Retirement System covers all state government employees who do not participate in another state sponsored plan. One large group that does not participate is state college and university faculty members. Eligible faculty and staff are members of the much larger Teachers Insurance and Annuity Association/ College Retirement Equities Fund (TIAA/CREF) system. Accordingly, the objective of this paper is to evaluate the performance of TIAA/CREF portfolios and the North Dakota Public Employee Retirement System pension fund portfolios, providing at least a relative performance assessment. After appropriate risk adjustment, it is hypothesized that the North Dakota pension fund portfolio is conservatively and less efficiently managed than the TIAA/CREF portfolios.

The first step in evaluating the performance of these pension funds is to calculate their one-period rates of return over some sample period. However, the rate of return alone is insufficient information on which to adequately evaluate a portfolio's performance, even though it is the single most important outcome from an investment. Both risk and return should be considered simultaneously. In addition, there are other aspects of portfolio performance that may be worth considering. Transaction costs, such as sales commissions and management fees, the skewness of returns, possible nonlinearities in risk-return trade-offs, a portfolio's security composition, shifting risk statistics, and the length of the time interval over which the investment returns are measured are some of the factors that can influence the welfare of the beneficiaries.

The purpose of this research is to explore potential improvements in the performance of the North Dakota Public Retirement System pension funds assuming the intended level of risk as specified in fund objectives, and to seek to control pension costs by detailed evaluations of pension portfolio managers' performances.

PENSION PLAN BACKGROUND AND OVERVIEW

A pension plan is a promise by an employer to provide benefits to employees upon their retirement. Contractual pension fund commitments are liabilities of the employer and must be disclosed in the financial statements. Modern pension funds essentially began 39 years ago when General Motor's president Charles Wilson proposed the establishment of a pension fund for GM workers. That pension fund was company-managed and was invested in the private sector of the American economy rather than in government securities alone as was common at that time. This approach had an unprecedented impact on pension fund management. Within one year of its inception, 8,000 new plans were set up and every one copied GM's innovaton.[1]

Public employee pension funds were relative latecomers to the equity capital markets. It was not until the late 1970's that many states liberalized the investment guidelines for their pension plans. New investment policies allowed public pension fund managers to achieve as high a return as private pension funds. No longer restricted to only the most conservative investments, the public employee pension funds have become diversified and their yields have been improved by using increasingly sophisticated management techniques.

Table 1 shows the rapid growth of pension fund assets in the U.S. over the past three decades. Private pension plans have grown at 12.5 % per year and government plans at 8.4 %. In 1980, 39.2 % of the private pension fund assets were with insurance companies, but the majority, 60.8 %, was controlled by the corporation via a pension fund trustee. In the meantime, as shown in the Table 2, the total assets of the North Dakota Public Employee Retirement System has grown at a phenomenal *annual* rate of 75 % over the past 10 years. It is estimated now that over 90 percent of all state government employees are covered under some form of public pension plan.

Cash inflows to the fund are provided by state and local government contributions, employer and employee contributions, dividends and interest earned by the funds's stocks and bonds, and capital gains. Cash outflows are management fees, brokerage expenses, disbursements to beneficiaries, and capital losses. Notice that most pension funds hold their assets in the form of marketable securities: money market accounts, bonds, and stocks. Because pension fund earnings are not taxed, it is not lucrative to hold municipal bonds since their low tax-exempt interest rates are

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[1] Drucker, Peter F., "The Unseen Revolution". New York: Harper & Row, 1976.

Table 1

Assets and Reserves of Major Pension and Retirement programs in the U.S.[2]
(Billions of Dollars)

	1950	1960	1970	1980
Private Plans				
With life insurance companies	$5.6	$ 18.8	$ 41.1	$ 165.8
Other private plans	6.4	33.1	97.0	256.9
Government Plans				
Railroad retirement	2.5	3.7	4.4	2.1
Federal civilian employees	4.3	10.8	23.9	75.8
State and local employees	5.2	19.6	58.2	185.2
Old-age, survivors' and disability insurance	13.7	22.6	38.1	26.5
Total	37.7	108.6	262.7	712.3

Table 2

Total Assets, Total Revenues, and Total Expenditure of the North Dakota Public Employees Retirement System[3] (Millions of Dollars)

	Total Assets	Total Revenues	Total Expenditures
1987	$ 260.9	$ 56.9	$ 9.9
1986	212.2	45.3	8.8
1985	174.2	36.8	7.0
1984	153.4	29.9	7.9
1983	123.0	32.8	9.3
1882	101.3	18.9	6.1
1981	86.5	21.9	4.9
1980	72.1	14.8	4.6
1979	62.0	11.7	4.8
1978	54.9	9.6	8.6
1977	33.6	7.5	4.3
1976	30.4	8.5	3.1

Sources: [2] Railroad Retirement Board, Social Security Administration, U.S. Department of Health and Human Services and Exchange Commission, and the American Council of Life Insurance.

[3] North Dakota Public Employees Retirement System Balance Sheets.

always dominated by the higher interest paid on taxable bonds. In addition, considering the fact that pension funds are in a zero tax bracket, heavy investment in real estate also might not be advisable because most real estate investments are priced such that the investor must be in a relatively high tax bracket in order to receive a positive after-tax return. Although the pension fund can profitably hold taxable securities, it is not immeditately clear what percentage of the fund's investment should be held in the form of interest - bearing securities (money market funds and bonds) or common stock. This choice will be discussed in later sections.

REGULATIONS AND CURRENT ISSUES

With the rapid growth of pensions as a form of deferred compensation, it has become more and more important for firms to fully disclose their pension commitments in their financial statements and for various pension practices to be regulated by law. The Financial Accounting Standards Board (FASB) has established the generally accepted accounting practices for reporting by pension funds (FASB NO. 35, 1980, No. 87, 1985). Abuses and inconsistencies in pension fund administration inspired the Employee Retirement Income Security Act (ERISA, 1974), which regulates various aspects of pension plans, including eligibility, vesting, funding, fiduciary responsibility, reporting and disclosure, and plan termination insurance.

There are two types of pension plans. *Defined contribution plans* consist of funds built up over time via employee and employer contributions with benefits not predetermined. Employees are simply paid the market value of their portion of the pension fund when they retire. The second, and more common type , is a *defined benefit plan* in which corporations are required to pay a contractual benefit upon the retirement of a vested employee. When ERISA was signed, defined benefit pensions were converted from corporate promises to liabilities enforceable by law.

ERISA legislates minimum corporate funding of defined benefit plans while the Internal Revenue Service (IRS) sets limits on the maximum corporate contribution. Thus ERISA and IRS restrictions limit corporate discretion over the amount of funds contributed to a plan. Although state and local government plans are excluded from ERISA guidelines, many state plans voluntarily comply with ERISA provisions. Thus the external environment is having a significant impact on the way pension funds operate.

The Senate Banking Committee recently heard testimony advocating the taxation of short-term trading profits of presently tax-exempt institutions. Several prominent financial experts are prescribing a cure for the short-term orientation of American business by taxing the short-term trader but not the long-haul investor. Will congress pass a law to tax pension funds? It has already set up *nondeductible* contributions to the Individual Retirement Account on a tax-deferred basis Any forms of taxation of pension funds would affect many potential beneficiaries including those covered by the North Dakota Public Employee Retirement System and the TIAA/CREF System. The administrators of both funds need to keep up with the current status of congressional action in this area. A change in investment strategy may be necessary if a tax on securities transactions involving pension funds becomes a reality.

In 1985, the Department of Labor first allowed corporate pension funds to enter into performance-based asset management fees. It has been discovered, through an industry survey conducted by Institutional Investor in 1987, that most investment management services have not been compensated in relation to their performance. The survey found that less than 4 % of the funds studied had installed incentive fee arrangements.[4] When asked about the industry trend, 36% of the respondents felt that incentive fees would eventually be arranged. Most of those in favor of the concept believed the chief advantage would be that money managers would have a further incentive to do well. Studies of some funds have shown that in about half the cases total fees would have been lower under a performance fee arrangement. Those opposed to the fees felt that the returns would not improve measurably. Still others indicated a fear that performance based fees might encourage managers to take larger risks or abandon their previous investment style[5]

Due to the large volume of equity transactions executed in pension plans, the plans would seem to be an excellent prospect for discount brokers. In reality, the discount brokers are having difficulty drawing pension funds as clients. Most pension fund officers avoid using discounters for several reasons. Some pension

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[4] As of March 1989, 2 out of 13 money managers of NDPER are subject to performance-based fees

[5] Institutional Investor"s Pensionforum, "Are Incentive Fees the Wave of the Future?" Institutional Investor, July 1987, 127-8.

administrators worry about the quality of trade execution. They are not willing to save a nickel on the commission and lose an eighth on the execution price as a result of market impact. Usually, the funds with outside managers leave the choice of a broker to the manager's discretion. As previously mentioned, the funds seem to be avoiding the discounters in favor of negotiating a lower fee with their current brokers[6].

There is currently much concern among pension managers over FASB statement #87. The FASB, together with the Securities and Exchange Commission (SEC), establishes the rules under which a firm reports its financial results. FASB #87 provided new rules regarding the reporting of pension costs and liabilities. Under the new rules, which will be phased in by the end of 1989, some pension plan information will be shown directly on the balance sheet. Pension liabilities as well as assets will have to be computed annually using the current market interest rates. This requirement is expected to lead to extreme volatility in the size of net pension positions. The answer to this situation would seem to be to match the durations[7] of the investments and the liabilities. Total immunization is inadvisable in the real world because the liabilities will be affected over time by inflation, salary increases, and interest rate changes.

FASB #87 should not affect public employee plans to a great extent. Indeed, the main fear of private pension plans is that a large pension liability will adversely affect the prices of their stocks. The ultimate effect of FASB #87 has yet to be seen.[8]

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[6] Ring, T., "Funds Not Rushing to Discounters," Pensions & Investment Age, September 7, 1987, 191-5.

[7]
$$\text{Duration} = \sum_{t=1}^{T} \left[\frac{PV(C_t)}{P_0} \times t \right]$$

where $(PV(C_t))$ is the present value of each cash flow to be received at time t, P_0 denotes the current market price of the bond, and T denotes the bond's remaining life.

[8] Rosenberg, H., "The Mad, Mad World of FASB #87", Institutional Investor, October 1987, 191-195.

A FUNCTIONAL DESCRIPTION AND OBJECTIVES OF THE NDPERS

The North Dakota Public Employees Retirement System utilizes a defined benefit pension plan. Retirement benefits are computed according to a formula based on years of service, a percentage multiplier, and the final 3-year average salary. As mentioned previously, this type of plan is popular because it provides a determinable benefit at a reasonable cost. The North Dakota pension plan is a contributory plan which means that both the employer and the employee share the cost in a prescribed proportion. The chief responsibility of the North Dakota Public Employees Retirement System is to make certain that money is always available to pay retirement benefits at any point in time. Consequently, the directors of the fund must find ways to maximize the amount of dollars available to meet plan liabilities. Sustained increases in employer contributions are not feasible in this budget-lean state, therefore, it is presumed that the only way to pump more money into the fund is to improve the rate of return on investments.

The official goal of the NDPERS set by the Board is "to provide income through various investments and employer and employee contributions, sufficient to pay benefits and allow for benefit enhancements as defined under the Retirement Act". It is the policy of the board of directors that the assets of NDPERS should be managed to keep the return at a maximum while meeting acceptable risk parameters. The NDPERS assets are to be invested in compliance with the "Prudent Person Rule". This rule of investments, developed by many years of court cases, states that while investing, reinvesting, acquiring, retaining , managing, and disposing of investments, judgment and care shall be exercised under the circumstances then prevailing, which individuals of prudence, discretion, and intelligence exercise in the management of their own affairs, considering the potential income as well as the degree of safety of their capital.

The Board sets additional guidelines that cover the areas of diversification quality, and restricted transactions. The long term objective of the fund is to achieve

a minimum return of 4.5% in excess of the annual rate of inflation. However, the return is to be no less than the 8% required to pay future benefits. The long term objective for performance is to rank above the 40th percentile of a data base composed of a popular investment measurement service.[9]

MANAGEMENT TECHNIQUES

The Investment Officer, with approval of the board of directors, engages several Investment Counselors to acutally invest the pension funds. The Investment Counselors have full discretionary authority in the selection and retention of investments. It is the duty of the Investment Officer to monitor the Investment Counselor's performance to assure that the agreed upon strategy is being followed. Consistency in investment philosophy and strategy should be maintained even though money managers with heterogeneous styles are selected according to their past performances.

Many different capital management companies and investment counselors are available to pension fund managers. Of increasing popularity today is the strategy of indexing or holding investments in such a proportion that they will track the Standard & Poor's 500 stock index. Currently about 30 percent of all pension fund assets are indexed. A reason for the popularity of indexing is the general belief that active managers cannot beat the market. There are, however, a number of investment strategies from which a fund manager can choose.

The Investment Counselors are, of course, restricted from making certain transactions. Restricted transactions include short sales[10] and investing in securities issued by governments other than the United States. Of prime importance is the directive that no transactions shall be made which threaten the tax exempt status of the fund.

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9 NDPERS uses Callan Associates Inc. (San Francisco) as an investment measurement service.

10 That is, borrow stock certificates from a brokerage firm in the initial trade, and sell them, hoping the share price will drop so there's a profit from returning cheaper shares to the lender.

MEASURING PENSION PLAN PORTFOLIO PERFORMANCE

Risk and Valuation

The basic model for evaluating the portfolio performance is based on the expected return and risk characteristics of securities and is a theoretical framework for analyzing risk-return choices. Accordingly, an objective of this study is to determine if the North Dakota pension fund achieves an efficient portfolio. An efficient portfolio is defined as one that has the smallest portfolio risk for a given level of expected return, or the largest expected return for a given level of risk.

The rate of return is the single most important aspect of an investment. However, in today's turbulent capital markets the rate of return by itself is not a sufficient indicator of a portfolio's performance. The rate of return is meaningful only when it is compared to some benchmarks. An appropriate measure of risk must be considered along with the return yield. Performance may then be evaluated on a risk-adjusted basis.

Generally, the riskiness of an investment is defined in terms of the variability of its anticipated returns. Note that the total risk (total variability) can be divided into two types of risk: (1) market-related risk, and (2) unique risk. Market-related risk, or systematic risk, is the portion of an assets' variability of returns which is attributable to a common source. This risk is the minimum level of risk that may be achieved by means of diversification across a large group of randomly selected assets. This systematic variability among all assets is due to changes in the economic, psychological, and political environment that affect all assets simultaneously. Unique risk or unsystematic risk is caused by events that are unique to the firm, such as strikes, inventions, management errors, and so on. Unsystematic risk and systematic risk sum to total risk as measured by the variance of returns of a security.

For an n-security portfolio, the measure of the total risk (variance) is

$$\mathrm{Var}(r_p) = \sum_{i=1}^{n} x_i^2 \,\mathrm{Var}(r_i) + \sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j \sigma_{ij} \quad \text{for } i \neq j \qquad (1)$$

where x_i is the weight of the security i in the portfolio , and σ_{ij} is the covariance between the returns on securities i and j.

Note that in the expression for the portfolio risk, the covariance terms between all possible pairs of securities in the portfolio are also included. The essence of effective diversification is to combine securities with either low or negative covariances. Therefore, demand for securities that have low or negative covariance of returns with most other securities will be high. As a result, the prices of securities which have low covariances with the market portfolio (i.e., low systematic risk) will be bid up. Since equilibrium rates of return move inversely with the price of a security, securities with low or negative covariances will have relatively high prices and, therefore, will experience low expected rates of return in equilibrium. Likewise, securities with high covariance with the market will require high expected returns.

The investor's required rate of return can be defined as the minimum rate of return necessary to attract an investor to purchase or hold a security. This return can be separated into its basic components: the risk-free rate of return plus a risk premium. This can be expressed as the equation:

$$R = RF + RP \qquad (2)$$

where R = the investor's required rate of return
RF = the risk- free rate of return
RP = the risk premium

The risk-free rate rewards the investor for deferring consumption without assuming any risk. Typically, the measure for the risk-free rate of return is the U.S. Treasury bill rate. On the other hand, the risk premium is the additional return an investor expects to receive for assuming risk.

Since no one knows exactly how to estimate the risk premium, we will use the most popular approach from the literature: the Capital Asset Pricing Model (CAPM). The CAPM is perhaps the most informative type of quantitative analysis that can be performed. The graphical presentation of the CAPM, called the Security Market Line (SML), discloses the "bottom line". It answers the fundamental question, "Was the portfolio's investment return justified by the amount of risk which was taken?"

The required rate of return on any asset, $E(R_i)$, is equal to the risk-free rate of return plus a risk premium. The risk premium is the price of risk multiplied by the quantity of risk. Thus, the expression for the required rate of return is

$$E(R_i) = RF + [E(R_m) - RF]\,\beta_i \qquad (3)$$

In the terminology of the CAPM, the price of risk is the slope of the line, which represents the difference between the expected rate of return on the market portfolio, $E(R_m)$, and the risk-free rate of return. β_i is the quantity of risk defined as follows:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} = \frac{\text{Cov}\,(R_i, R_m)}{\text{VAR}\,(R_m)} \qquad (4)$$

Thus, β_i is the covariance between returns on the risky asset, i, and the market portfolio, m, divided by the variance of the market portfolio. Therefore, the expected return from a security is an increasing function of its systematic risk as measured by its covariance with the market. The risk-free asset has a beta of zero because its covariance with the market portfolio is zero. The market portfolio has a beta of one because the covariance of the market portfolio with itself is identical to the variance of the market portfolio.

Note that the total risk (total variability) of a portfolio can be divided into two types of risks: (1) *unsystematic risk or unique risk*, and (2) *systematic risk or market risk*. Unique risk can be diversified away. Market risk is nondiversifiable risk; it cannot be eliminated, no matter how much we diversify. Since we can remove the unique risk, there is no reason to believe that the market will reward us with additional returns for assuming risk that could be avoided by simply diversifying. Hence the relevant risk in the portfolio management is the unavoidable systematic risk. A measure of this market risk is the beta.

Portfolio Performance

The North Dakota pension fund's assets are invested in two categories of instruments. These are known as equities and fixed income assets. The equity portion consists of common and preferred stocks, while the fixed income portion is invested in government securities, corporate bonds, and mortgages. Currently about 55 % of the fund is invested in equities and the remaining 45 % is invested in fixed income assets.

The state college faculty members participate in the TIAA/CREF System which serves as a basis of comparison for this study. The College Retirement Equities Fund (CREF) is similar to the State's Equity component, while the Teachers Insurance and Annuity Association (TIAA) functions like the State's fixed income component. Currently 52.5 % of such funds are invested in the TIAA fund and the remaining 47.5 % are invested in the CREF.

These percentages have allowed the formation of a composite fund for each system using a weighted average of the components. Tables 3, and 4 show each fund's components and composite for the years 1971-1986. A 10 year average return, and the standard deviation were all computed from the data sets. The beta of each portfolio's component and composite was calculated using the S & P 500 as a proxy for the market portfolio.

As was mentioned, the beta value is the measure of the systematic risk. In general, if a security or portfolio's beta equals 1, its returns will vary in direct proportion with the market's return. When a beta is larger (smaller) than 1, an investment's returns are more (less) responsive to changes in the market, whether the returns are increasing or decreasing. In other words, if a beta value is larger (smaller) than 1, it is an agressive (conservative) investment. The risk level of the equity portion of the North Dakota pension fund is very similar to that of the market. However, the overall risk level indicates the composite fund is taking a somewhat defensive approach.

In the case of the TIAA/ CREF, the risk levels of both funds are lower than that of the market. Both betas of the CREF and TIAA are lower than those of the equity portion and the fixed income portion of the North Dakota fund, but returns of CREF/TIAA are higher than the returns of their North Dakota fund counterparts.

Table 3

Ten Years of Return Yields for the North Dakota Pension Fund

	Equities	Fixed Income	Composite
1986	12.51%	16.19 %	12.91 %
1985	32.89 %	16.17 %	22.49 %
1984	1.15%	13.64 %	6.55 %
1983	23.13 %	6.54 %	13.72 %
1982	19.77%	33.26 %	27.36 %
1981	- 7.00 %	6.29 %	0.09 %
1980	28.32 %	- 3.98 %	12.63 %
1979	26.46 %	0.81 %	12.71 %
1978	5. 29 %	0.54 %	4.48 %
1977	-8.58 %	3.14 %	- 1.39 %
Average	13.39 %	9.26 %	11.19 %
Variance	2.02 %	1.07 %	0.75 %
Std. Dev.	14.23 %	10.33 %	8.64 %
Covariance with Market	0.02	0.00	0.01
Beta	1.04	0.14	0.54

Table 4

Ten Years of Return Yields for the TIAA/CREFF System

	CREF	TIAA	Composite
1986	21.82 %	21.82 %	16.42 %
1985	32.68 %	11.66 %	21.64 %
1984	4.69 %	11.50 %	8.27 %
1983	25.09 %	11.07 %	17.73 %
1982	21.86 %	10.73 %	16.02 %
1981	-1.46 %	10.11 %	4.61 %
1980	25.68 %	9.44 %	17.58 %
1979	26.59 %	8.97 %	12.23 %
1978	8.68 %	8.71 %	8.70 %
1977	6.44 %	8.39 %	7.46 %
Average	16.22 %	10.21 %	13.07 %
Variance	1.12 %	0.01 %	0.28 %
Std. Dev	10.57%	1.19 %	5.30 %
Covariance with Market	0.01	0.00	0.01
Beta	0.75	0.04	0.38

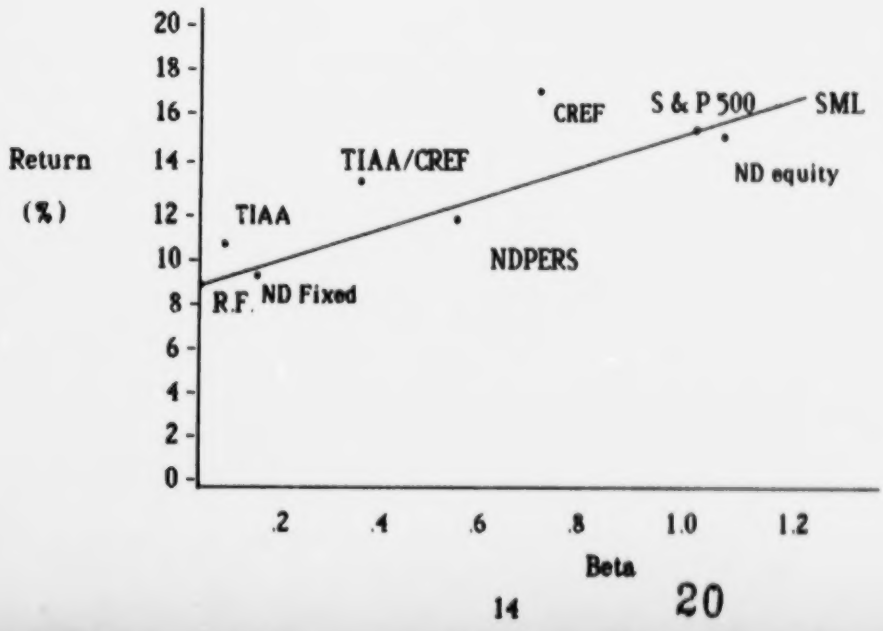
Performance Measure With the CAPM

In theory, all assets should lie on the Security Market Line (SML) in equilibrium, because both portfolios' and individual securities' returns are determined by systematic risk. A point which falls above the SML represents an asset with an unusually high return for the amount of systematic risk it bears, so it will enjoy strong demand, which will bid its price up until its equilibrium rate of return is driven back to the SML. Likewise, a security represented by a point below the SML does not offer a sufficient return to induce rational investors to accept the amount of systematic risk it bears. As a result, its price will fall owing to lack of demand.

Graph 1 shows the positions of the North Dakota and TIAA/CREF funds relative to the Security Market Line. As shown in the graph, the TIAA, CREF, and TIAA/CREF composite are all located above the SML. Alternately, the ND equity component, the ND fixed income component, and the ND composite fund are all located below the SML. Again, in plain words, portfolios that plot above the SML are said to be good performers, while those that plot below are not achieving an adequate risk-adjusted return. According to the graph, the TIAA/CREF fund is more effective than the North Dakota fund and it is adding more relative value. The return that the North Dakota fund is achieving cannot be justified by the risk that has been taken by the SML criterion.

Graph 1

TIAA/CREF and NDPERS Ten-Year Average Risk-Return Trade-off in Relation to the Security Market Line (SML)



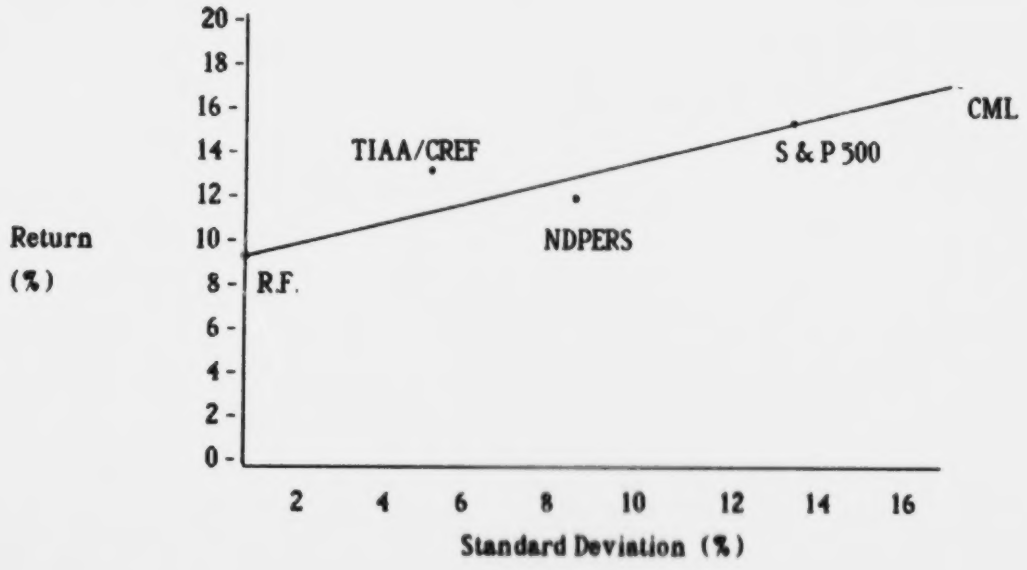
Note that the CAPM has weaknesses. For example, we might well question whether the risk of an asset can be totally captured in the single dimension of sensitivity to the market. Also, some would argue that we cannot verify the accuracy of the model because we cannot know with certainty that we are using the "true market portfolio" in comparing returns and systematic risk. A major problem with the CAPM model is that it is formulated on an ex ante basis but used on an ex post basis. However, the model does offer an insight into portfolio efficiency and allows a comparison of different investment funds.

Evaluation With the CML

Capital market theory provides an additional method of quantitative analysis, called the Capital Market Line. The CML traces out the risk-return trade-off for efficient portfolios. In other words, in equilibrium, only efficient portfolios will lie on the CML. The model is similar to the CAPM in that the same proxies are used for the risk-free rate of return and the market's return. Instead of using beta as a measure of expected risk, the standard deviation is used. Graph 2 shows the positions of the two pension funds' performances relative to the CML.

Graph 2

TIAA/CREF and NDPERS Ten-Year Average Performance in Relation to the CML



Since the North Dakota fund falls below the CML, the conclusion implied by this graphical presentation is that the North Dakota fund is inefficient. The pension fund is not achieving an adequate risk-adjusted rate of return.

Other Approaches

Based on the concepts of capital market theory and the CAPM, and recognizing the necessity to incorporate both return and risk into the analysis, we can propose two more measures of portfolio performance: Sharpe's Reward to Variability (RVAR) and Treynor's Reward to Volatility (RVOL). Both measures relate the excess return on a portfolio to a measure of risk. The excess return is defined to be the holding period yield less the risk-free rate of return. Sharpe's RVAR uses the standard deviation as a measure of risk and Treynor's RVOL uses beta. Thus,

$$RVAR = \frac{HPY_p - RF}{SD_p} = \frac{\text{Excess return}}{\text{Risk}} \qquad (5)$$

where HPY_p = the average holding period yield for portfolio p for the period.

RF = the average risk-free rate of return for the period.

SD_p = the standard deviation of return for portfolio p during the period.

The higher the RVAR, the better is the portfolio performance. Since this is an ordinal or relative measure of portfolio performance, different portfolios can easily be ranked using this variable. Using this measure, the portfolio with the highest RVAR would be judged best in terms of ex post performance. Treynor's Reward to Volatility (RVOL) is defined as

$$RVOL = \frac{HPY_p - RF}{\beta_p} \qquad (6)$$

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or

$$\text{RVOL} = \frac{\text{Average excess return on portfolio p}}{\text{Systematic risk for portfolio p}}$$

Where β_p is the beta for portfolio p.

In this case, we are calculating the excess return per unit of systematic risk. As with RVAR, higher values of RVOL indicate better portfolio performance. Portfolios can be ranked on their RVOL, and assuming that the Treynor measure is a correct measure of portfolio performance, the best performing portfolio can be determined.

Table 1 shows how the two pension fund composites compare to each other and to the market, based on the RVAR and RVOL . The performance measures indicate that the TIAA/CREF composite has outperformed the NDPERS composite as well as the market on the basis of its excess return to risk ratio.

Table 5

Comparison of Portfolio Performance

Fund	Sharpe's RVAR	Treynor's RVOL
TIAA/CREF Composite	.76	10.69
S & P 500 Index	.42	5.53
NDPER Composite	.25	3.98

Again, both measures indicate the TIAA/CREF fund outperformed both the market and the North Dakota pension fund. Over the period analyzed, differences in rankings can result from a lack of complete diversification in the portfolio. The choice of which measure to use depends upon the type of risk that the investor thinks is correct.

CONCLUSIONS AND RECOMMENDATIONS

Several financial analysis models have been utilized in this study to compare the investment performance of the NDPERS pension fund to the TIAA/CREF pension fund. The four quantitative analysis methods all indicate that the NDPERS has not earned a sufficient risk-adjusted rate of return. Not only has the TIAA/CREF system earned a higher rate of return as compared to the NDPERS, but its portfolio risk was lower. Portfolio risk, as measured by beta and the standard deviation of returns, was relatively high for the NDPERS portfolio when compared to the TIAA/CREF system. The rate of return has been simply insufficient to justify the risk that was taken. The North Dakota Pension Fund needs to either improve its rate of return without raising the risk level, or lower their portfolio risk while sustaining the current rate of return.

The following recommendations are based on the conclusions made from analyzing the data of this study. While the effects of these proposed courses of action on the fund could not readily be studied, they do represent a logical alternative to the present system. These recommendations are worthy of further study and serious consideration.

As mentioned, the portion of the pension fund invested in fixed income securities has not achieved a return commensurate with the risk involved. The NDPERS should reallocate this portion of the fund to some investment that would earn a better rate of return without increasing the level of risk. This requires active methods of bond management. That is, the portfolio manager should try to identify mispriced bonds or to "time" the bond market by accurately predicting interest rates. Market timing, for example, implies buying long-term bonds when interest rates are predicted to fall and replacing them with short-term bonds when interest rates are predicted to rise.

As for reducing the risk level without hurting return, the concept of "duration" can be utilized. As described in the earlier section, this technique will allow a bond portfolio manager to be relatively certain of being able to meet a given promised stream of cash outflows. Thus, once the portfolio has been formed, it is "immunized" from any adverse effects associated with future changes in interest rates. Immunization is accomplished by simply calculating the duration of the promised outflows and then investing in a portfolio of bonds that has an identical duration. Note that the duration of a portfolio of bonds is equal to the weighted

average of the durations of the individual bonds in the portfolio.

Another alternative worth considering for the fixed income category is preferred stock. Particularly, adjustable rate preferred stock (ARPS) where the dividend is reset periodically based on an applicable rate is recommended. In this case, the annualized "percent of par" for the dividend might be reset every three months to be equal to the largest of the rates on 1) 3-month T-bills; 2) 10-year T-bonds; and 3) 20 year T-bonds. Another alternative related to ARPS are Dutch Auction Rate Preferred Stocks (DARPS), where the dividend is reset periodically (more often than for ARPS) at a level that results from bidding by current and potential owners.

As shown in Graph 1, the equity portion of the North Dakota fund lies below the ex post SML. Accordingly, its performance would be viewed as inferior. Having an average beta over the period that is greater than the market portfolio's beta of 1 indicates that this component of the fund was aggressive. However, the return is lower than that of the S&P 500 market proxy. Since the equity portion is not beating the market return, we might recommend indexing of the fund as a solution. If the fund were indexed, the return would track the market's return.

One of the most important tenets of modern portfolio theory lies in the necessity to diversify. A "well diversified" portfolio will have a negligible amount of unique risk. This means that its total risk will be approximately equal to the amount of market risk that is present. Accordingly, North Dakota funds should be broadly and efficiently diversified. Another important element that fund managers should consider to keep the fund's portfolio from being hurt by fierce market gyrations is a hedging strategy. This is similar to trading pairs of stocks in the same industry. For example, we buy a stock that is expected to be strong in a given industry group, and at the same time we sell short an equal dollar amount of a company in the same group that is expected to be weaker. If the overall market or a certain stock group plunges, naturally the stocks which we have shorted as well as those we own will drop in price. Note that in this case, it is imperative to avoid shorting stocks that are likely to become takeover targets. Versions of this so-called "competitive hedging" have been growing more popular among Wall Street's money managers after the 1987 market crash.

If the present system of active management is retained, some improvement may be realized by reducing transaction costs. The use of discount brokers should be investigated. There are some brokers, such as Abel/Noser Corp. that do business exclusively with large institutional investors and are very responsive to their needs. The potential savings in transaction costs could be quite large. Also, the use of incentive fees for money managers might be expanded. If an investment manager can "beat the market", then he should be rewarded. Should the money manager not perform as well as he had claimed he would, a savings in management fees would be realized.

Another alternative for the NDPERS to consider is a switch to a defined contribution system. The state simply promises to pay a fixed percentage of each employee's salary or wages into the defined contribution plan. Benefits upon retirement depend on the return on pension assets. This type of plan can hold down costs because the annual contribution is determined at the outset of the plan. It produces a variable benefit, but it eliminates a fund surplus and the temptation to use it for other than retirement benefits. Currently there is a proposal to use the NDPERS surplus for a venture capital fund for North Dakota businesses. The objective is not to earn a high return for the NDPERS, but to create jobs by stimulating the economy. This is a political proposal that may not be in keeping with the fiduciary responsibility of the pension fund.

The state should investigate the 401K tax -deferred savings plan authorized by the Internal Revenue Act of 1978, and consider making it available to state employees. Employees contributing to the plan reduce their tax liabilities and earn tax-free returns until retirement. If this type of plan were available, employees could choose to invest additional capital in the pension fund. The larger pension fund should face a greater diversity of investment opportunities. The 401K has proved to be very popular where it is available.

In addition, it may be shown that for the state to improve the performance of its funds, the several different pension funds must be reorganized. For instance, we can recommend bringing the Teachers Fund for Retirement and the Highway Patrolmen's Retirement System into the Public Employees Retirement System. This consolidation would reduce administrative overhead and standardize management procedures. The resulting fund would be much larger than the current NDPERS fund and should

therefore have more investment opportunities.

Furthermore, the state may have to consider using a computer modeling technique to adjust the equity/fixed income asset allocation. The allocation has remained fairly constant over the past few years. Shifting the asset allocation would allow the investment managers to take advantage of short term trends.

One of the major themes of modern portfolio theory concerns the merits of diversification. So far, this has been discussed in terms of traditional securities, such as stocks, bonds and other derivative securities. However, the fund managers should also consider holding foreign securities and tangible assets. International diversification can significantly reduce the risk of portfolio returns. Returns from different national equity markets have relatively low correlations with one another. In fact, the variance of an internationally diversified portfolio seems to be as little as 30 % of that of individual securities.[11] The benefits from international diversification would be much greater than those that could be achieved only by adding more domestic stocks to a portfolio. In most countries, there are indices of overall stock values and of the values of stocks within various industries or economic sectors. Such indices can be used for assessing "market moves" within a country as well as among countries. On the international level, the indices produced by Morgan Stanley Capital International Perspective are widely used for such purposes. Several of the Morgan Stanley indices are published daily in the Wall Street Journal.

More often than not, marketable securities such as stocks and bonds have provided returns that were relatively disappointing, especially after adjusting for inflation. Neither bonds nor stocks have served as good hedges against unanticipated inflation in recent years. Overall, tangible assets have been better hedges against inflation. One example which might be considered for the NDPER fund is gold.

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[11] Solnik, B. H., "Why Not Diversify Internationally Rather Than Domestically ?" Financial Analysts Journal, July- August 1974, P. 51.

During the period, 1960-1984, gold price changes were slightly negatively correlated with stock returns (correlation coefficient : - .09).[12] Similar results have been obtained for other periods. Accordingly, gold seems to be an effective diversifying asset for equity investments. In the same periods, its average return was higher than the U.S. equity returns (10.2 % vs 12.62%).[13] Gold prices were highly correlated with the rate of inflation in the U.S. as measured by changes in the Consumer Price Index.[14] This is consistent with gold's traditional role as a hedge against inflation.

Another area of tangible assets the NDPERS funds might be attracted to is real estate. As mentioned earlier, heavy involvement in real estate is not desirable, but some portions of the funds may well be diversified in this area. Investments in real estate have greatly accelerated since the October market crash, as many fund managers perceive real estate to be a good hedge against inflation and as they think they need something that isn't correlated with stocks. Hence, public pension fund investment in equity real estate is projected to increase to $ 41 billion in 1990 from $ 13.5 billion in 1987.[15] Indeed, real estate proved to have been an attractive inflation hedge until recent years. For example, compared with the common stocks, private residential real estate has shown higher sensitivity to the expected inflation (sensitivity coefficient: 1.27 vs - 4.26) as well as to the unexpected inflation (sensitivity coefficient: 1.14 vs - 2.09) during 1959 to 1971.[16]

Finally, the question of taxation of pension funds continues to be brought up in Congress. The funds managers should contact North Dakota's Congressional Delegation and express their concern about this issue. If some type of taxation is implemented, the investment strategy of the fund will have to be revised rather drastically.

12,13,14 Ibbotson, R. G., L.B. Siegel, and K.S. Love, " World Wealth: Market Values and Returns," Journal of Portfolio Management, 12, Fall 1985, 17-21.

15 Lowenstein, R., " Pension Funds Rush Into Real Estate." Wall Street Journal, August 22, 1988.

16 Fama E. and W. Schwert, "Asset Returns and Inflation," Journal of financial Economics 5, no, 2 November 1977, 130-1.

SUMMARY

The North Dakota Public Employees Retirement System is responsible for providing dependable retirement income for the state's employees. This study has investigated the portfolio performance of the North Dakota pension fund's investments. Evaluating performance involves determining the average return and risk of the portfolio over some time interval. Two measures of risk often used are : beta value and standard deviation. Sometimes the average return and risk are looked at separately, and sometimes they are combined into a single risk-adjusted measure of performance. For such risk-adjusted measures, the NDPER funds were compared to the much larger TIAA/CREF funds using the CAPM model, Capital Market Theory, Sharpe's RVAR, and Treynor's RVOL.

In evaluating performance, there are two major tasks. First, it is important to try to determine whether the performance is superior or inferior. Second, it is also important to try to determine if a portfolio's performance has been the result of skill or luck. After all, if superior performance was due to skill, then such performance can be expected to continue in the future. In principle, good performance can be rewarded, while poor performance can result in changing either the constraints placed on the manager, the investment objectives given to the manager, or the size of the portfolio for which the manager is responsible.

For the given data, it has been shown that the North Dakota pension fund has achieved an average return that is less than the risk-adjusted required rate of return. In comparison to the TIAA/CREF system, which has outperformed the market, the NDPERS fund appears to be a low performer.

However, comparing the pension fund of a small conservative state like North Dakota to the huge TIAA/CREF system may not be entirely appropriate. The North Dakota pension fund is simply not playing in the major leagues. Vastly different investment opportunities exist for the TIAA/CREF fund because of the large amount of funds it controls.

It is not the conclusion of this study that the NDPERS is poorly managed. Indeed, the NDPERS is achieving the objectives required of it. The fund has enjoyed a return in excess of what is required to pay future benefits. Even though the North Dakota pension fund is achieving its objectives, there is an opportunity for improvement.

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